Universität Basel

Swiss Nanoscience Institute

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EINE INITIATIVE DER UNIVERSITÄT BASEL UND DES KANTONS AARGAU

Denaturing proteins

Proteins are large molecules — or "macromolecules" — that are made up of amino acids. They appear in all of the body's cells and play an essential role as building materials and nutrients. Hormones transmit signals between cells, antibodies protect us against pathogens, enzymes catalyze our metabolism and accelerate biochemical processes, structural proteins form the framework of cells and tissues, and transport proteins bind to substances and carry them to their destination. Proteins can only perform all of these functions in their natural structure, which has a specific three-dimensional configuration that comes about thanks to hydrogen bonds and disulfide bridges as well as ionic bonding. A breakdown of this three-dimensional structure is referred to as denaturing and means that the enzymes can no longer split molecules and antibodies can no longer bond to the antigens of pathogens. What causes the denaturing of proteins and what does it look like?

What you'll need:

- 4 glasses
- Measuring jug
- 1 raw egg
- 2 small bowls
- Fork
- Scissors
- Kettle
- Tap water
- 75 ml isopropyl alcohol (isopropanol)
- Pen and paper

Instructions:

1. First, label the four glasses: control, tap water, isopropyl alcohol, hot water.
2. Then crack the egg and separate the white from the yolk.
3. Using the scissors, cut the egg white up into small pieces.
4. Now place a quarter of the egg white into the "control" glass.
5. Put 75 ml tap water in the second glass, 75 ml isopropyl alcohol in the third, and 75 ml hot water in the fourth.
6. Now add a quarter of the egg white to the second, third and fourth glasses.
7. Watch what happens.

Egg white


Egg white in tap water


Egg white in isopropyl alcohol


Egg white in hot tap water

⟶ The egg white in the tap water forms very fine white threads, which are more pronounced in the hot water. The proteins have denatured. A sizable clump has formed in the alcohol as a result of vigorous precipitation of the protein.

Want to know more?

Proteins consist of a specific sequence of amino acids, which is known as the primary structure. The secondary structure comprises the three-dimensional structure in a localized area of the protein (e.g. α-helix, β-sheet). The tertiary structure refers to the three-dimensional structure of a subunit, and the quaternary structure to the three-dimensional structure of the overall protein complex. Hemoglobin, for example, consists of four subunits: two α-chains and two β-chains.
With the help of crystal structure analysis, researchers are attempting to decode the structures of all known proteins and collect them in the Protein Data Bank.